Before the

Federal Communications Commission

Washington DC 20554

In the Matter of	)	
	)	
Spectrum Policy Task Force Report	)	ET Docket No. 02-135
	)	

COMMENTS OF VANU, INC.

Vanu, Inc. hereby files these comments in the above-captioned proceeding. [1]

INTRODUCTION

A. Summary

Vanu, Inc. strongly supports the findings in the Spectrum Policy Task Force Report. Introducing more flexibility in spectrum regulation will help to increase the efficiency of spectrum utilization, mitigate interference issues, spur innovation and better meet the needs of the public in a wide variety of situations such as densely populated metropolitan centers, rural areas and individual home or in-building wireless use. Flexibility is needed at every level, from the ability to change what frequencies are used all the way up to the how the policies are implemented. Software-Defined Radio (SDR) technology brings unprecedented flexibility to wireless systems,

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1 *Spectrum Policy Task Force*, ET Docket No. 02-135

and will be able to take advantage of new, more flexible regulatory policy. SDR technology has advanced significantly in the last 10 years, to the point that it is a viable and cost effective alternative to traditional, inflexible, hardware-based infrastructure.

B. About Vanu, Inc.

Vanu, Inc. was formed in 1998 to explore the feasibility of building software radios using object oriented computer languages running in application space on general-purpose processors. The extent to which Vanu uses software to implement signal processing distinguishes us from other radio developers. In the nomenclature of the SDR Forum, Vanu develops "software radios" which is a type of "software defined radio" that not only defines the processing in software but also performs the processing in software. Pushing more processing into software permits our products much greater flexibility to adapt the nature of the signal processing performed by the radio.

For more information, see Appendix A and www.vanu.com.

DISCUSSION

C. Spectrum Efficiency

Vanu, Inc. supports the Task Force's findings that advances in technology create the potential for systems to use the spectrum more efficiently. Not only does SDR enable faster migration to new, more spectrally efficient standards, but SDR can also be used to create dynamic systems that can be optimized to the current spectrum conditions. This provides a clear advantage over hardware-based systems, which are optimized for worst case conditions and inefficiently use spectrum during times when noise and interference is not worst case.

Advances in technology now allow wireless systems to use spectrum more flexibly, and we agree that it is time for spectrum policy to become more flexible to exploit these advances. We agree that these policies should be implemented in both newly allocated bands as well as spectrum that is already in use. If these policies were only implemented in newly allocated bands, today's inefficiencies in the most valuable pieces of spectrum would persist. SDR can play a key role in speeding this transition by bringing flexibility to wireless systems to match the proposed flexibility in regulation.

We strongly disagree with the notion that the current regulatory model should be maintained for the broadcast spectrum. The most egregious wastes of spectrum occur within these bands, and these inefficiencies must be addressed. These bands have propagation characteristics that are very desirable for a wide range of uses, but most of the band sits idle in most areas.

D. Spectrum Rights Model

In general, we suggest that the Task Force migrate toward systems that use lower power. Lower power systems enable better spatial reuse, which is the best way to enhance spectrum efficiency in areas where there is high demand for spectrum. Higher-powered systems may be a more economical way to meet these needs in rural areas, however, where more efficient use of spectrum is a lesser concern due to lower demand. We support the Task Force's efforts to find ways to promote spectrum access in rural regions, such as flexible regulation of power levels.

Underlay rights should be implemented in every band, with the underlay limits increasing over time. This will not only allow more users access to the same spectrum for different uses, but will also spur innovation to an even greater degree than the ISM bands already have. Underlay rights are en excellent mechanism to take advantage of spectrum inefficiencies resulting from varying spectrum use as a function of time and geography.

While backwards compatibility is necessary, the movement to a new regulatory regime should start now. The Task Force suggests a possible path for this type of migration, in fact, when discussing the admission of multiple lower power transmitters for HDTV stations. If TV systems in general migrated to a larger number of lower-power transmitters, they could provide better coverage while reducing interference issues and more efficiently utilize spectrum. We know this can't be changed immediately, but migration toward new regulations now will ultimately prove beneficial.

We support the four spectrum rights parameters that the Task Force has outlined, and we believe a fifth parameter should be added – time. Just as there are restrictions to the geographic scope of right to operate, scope can be restricted similarly by time. Time may be a key component for many sub-licenses, for example, a user may lease out a portion of spectrum for other users at night when the load is not heavy.

We very strongly support the encouragement of experimental uses of spectrum in order to spur innovation and to best work within these spectrum rights parameters. In particular, we agree that opportunistic spectrum use provides significant benefits, and we believe that SDR's operational flexibility makes it very well suited to the task. By operating in unused spectrum, these radios make the most efficient use of spectrum.

Though there is a short-term benefit to international harmonization, SDR will make this a non-issue in the long term. Since SDR systems are not locked to specific channels, bands or standards, they can adapt to different spectrum allocations in different countries.

E. Interference Rights

As a result of the dramatic increase in the complexity of predictive models, we agree that a measurement approach is the only sensible way to proceed. While defining and determining interference temperature is a necessary but difficult challenge, there are steps that can be taken in the interim while these issues are being resolved.

In the GSM system, for example, handsets provide measurement reports to the basestations. A similar reporting mechanism in handsets could be used to report simple measurements of signals and noise/interference. As the Task Force notes, it is not the interference at the tower that matters, but the interference at the handset. This approach has the benefit of providing interference measurements at the handset, and only where and when handsets are being used.

We agree with the Task Force and support the fundamental objective of promoting access to and use of radio spectrum. However, we believe grouping spectrum neighbors is a short-term necessity, but should not be an issue ongoing forward for a properly designed policy. Instead of introducing good neighbor incentives, we believe that proper policy regarding adjacent channel emissions will solve interference problems. Then, within those limitations, neighbors can be appropriately grouped if necessary. We believe that incentives to lower power would be more beneficial, enabling better spatial reuse and reducing adjacent channel emissions.

F. Receiver Requirements

We agree with the Task Force's recommendation that receiver performance requirements should be applied within some bands or services. This recommendation is extremely important, as many interference problems in public safety and TV bands are the result of poor receivers that cannot operate under interference from nearby bands or channels. This problem has led to restricted use of those other bands, and consequently, significant inefficiencies in spectrum use.

We suggest that the receiver requirements be broken down into three categories: co-channel interference, adjacent channel interference and background noise.

Co-channel interference refers to the amount of signal one user can tolerate from another user transmitting on the same frequency. This situation exists in cellular planning, where the same frequency is reused by different cells, but the cells are placed far enough apart so that the signal level from one transmitter does not cause significant interference with the other. Co-channel interference receiver requirements are very important for enabling spectral reuse.

Receiver requirements on adjacent channel interference are critical for allowing systems to co-exist, and to allow new systems to be deployed in bands adjacent to existing systems with some degree of certainty that they will not degrade the existing system.

The interference problems between some public safety and SMR systems serve as a good example. If the adjacent channel interference limit had been placed on public safety radios when they were certified, then the SMR systems could have been designed to limit their adjacent channel emissions to within the limit that the public safety radios. However, there were not limitations on the adjacent channel rejection of public safety radios, meaning some have trouble with interference from SMR systems while others do not. A receiver standard for adjacent channel rejection would prevent this kind of interference problem in the future.

Background noise is omnipresent, and affects a receiver's operation under normal conditions, but must also be considered as another source when examining co-channel and adjacent channel interference issues. It is important to specify the background noise level under which a receiver is expected to operate in order to properly assess performance in all situations. We do not believe that minimum receiver performance requirements would stifle innovation.

Additionally, performance under these types of receiver requirements can be easily verified by simple reception tests, and would not add a significant burden to the certification process.

G. Rules and Enforcement

We understand that enforcement is a significant undertaking, but we believe that by adopting quantitative standards, the enforcement burden will be eased. By using simple constraints and focusing measurement, enforcement would be simplified to times and areas where transmitters are actually in use.

The technical challenge presented by the adoption of quantitative standards is significant, but we believe it is necessary and will greatly benefit spectrum use in the long run. We would like to request that the FCC commission studies, reports and Testbeds to perform the necessary to implement these new standards.

We support the Task Force's efforts to remain agnostic regarding the regulation of technology. We caution the Task Force in the case of trunking, as the report's discussion of this topic moves toward defining specific technologies for use, rather than mandating more efficient use of the spectrum. Trunking is only one way to make more efficient use of spectrum. In addition to other current methods, there will be new methods in the future that have yet to be defined.

Finally, we believe that a periodic review of rules is crucial for successful spectrum regulations. Rules should be designed for the most current technology.

SDR, through software downloads can speed the deployment of new technologies, and we believe that the rate of migration will increase over the next several years. We suggest a time frame for the first review of any new regulations, with a shorter time frame for the subsequent review in order to keep pace with technological advances.

H. Summary

We support the Task Force's initiative to give spectrum users the maximum possible autonomy in the areas of service or use choice, choice of appropriate technology, and the right to transfer, lease or subdivide spectrum rights.

In the choice of use or service provided on spectrum, SDR allows the maximum flexibility because of its inherent ability to support multiple systems, standards and applications. It is adaptable to changes in spectrum rules and environments, since changes can be made to the software alone, preserving existing hardware.

Finally, SDR is well suited to transfer, lease, or subdivision because of its flexibility. By design, SDR systems are not limited to specific spectrum, but can move dynamically to unused spectrum, whether that is defined by time, frequency, power, geographic space, or interference level.

Appendix A: Vanu, Inc.

Focusing on the complex software problems of Software Defined Radio (SDR), Vanu, Inc. licenses SDR components and applications and provides design-consulting services to wireless OEMs, system integrators and service providers. The company targets three basic platforms, each addressing a distinct market segment: infrastructure, vehicular and handheld.

Vanu, Inc. has revolutionized SDR through the development of Vanu Software Radio, applying modern software engineering techniques to the high-speed signal processing elements at the core of wireless devices. This approach leads to much greater flexibility and upgradeability of deployed devices, and software portability across multiple platforms.

Moore’s law shows that processor performance doubles every 18 months, a trend which is likely to continue for some time. Vanu Software Radio is ideally suited for general-purpose processors (GPPs), where Moore’s law combines with commodity pricing to give the highest price/performance ratio. Vanu, Inc. uses advanced engineering techniques to produce software that can run on a wide range of processing platforms, allowing customers to choose the best processor for their application. By targeting GPPs and developing software in high-level languages, Vanu Software Radio systems become portable, modular and reusable, minimizing the amount of code that has to be re-written to keep pace with advances in the underlying technology.

Vanu Software Radio implements all waveforms and signal processing in software rather than hardware. This approach leads to systems that can change dynamically and quickly. In addition, Vanu Software Radio systems can be deployed on commercial-off-the-shelf (COTS) hardware, minimizing the customer’s hardware engineering effort and reducing time to market for new products. These benefits, coupled with lower development costs due to software reuse, provide substantial advantages over traditional radio architectures.

Vanu Software Radio delivers unparalleled value in the advancement of SDR solutions. Wireless manufacturers will no longer need to constantly upgrade their hardware in order to keep pace with newly released technologies and standards. Vanu Software Radio equipped devices simply download software over the air, thus reducing operating costs and increasing revenue opportunities.

Vanu, Inc. was founded in 1998 and is based in Cambridge, Massachusetts. The company is active in military, public safety, and commercial applications of SDR.